Introduction to LANs Networld + Interop

Developed & Presented by

Ray Horak

The Context Corporation

1500A East College Way, PMB 443

Mt. Vernon, WA 98273

Tel: 360.428.5747

Fax: 360.416.3378

E-Mail: ray@contextcorporation.com

www.contextcorporation.com

Suggested Reading

www.commweb.com

Local Area Network (LAN) Characteristics

- Shared Medium

- Packet Network

- Limited Distance

- Bandwidth = 1-100 Mbps+

- Packet Size up to 1.5+ KB (Ethernet)

- IEEE Standards (802.x)

Transmission Media

≤ 500 m

≤ 2.5 km

Ethernet

Multiple Ethernet or STARLAN Segments

Ethernet

Modem or DSU

Ethernet Bridge

Remote Link

Modem or DSU

Ethernet

Ethernet

R
o
u
t
e
r

©Context Corporation
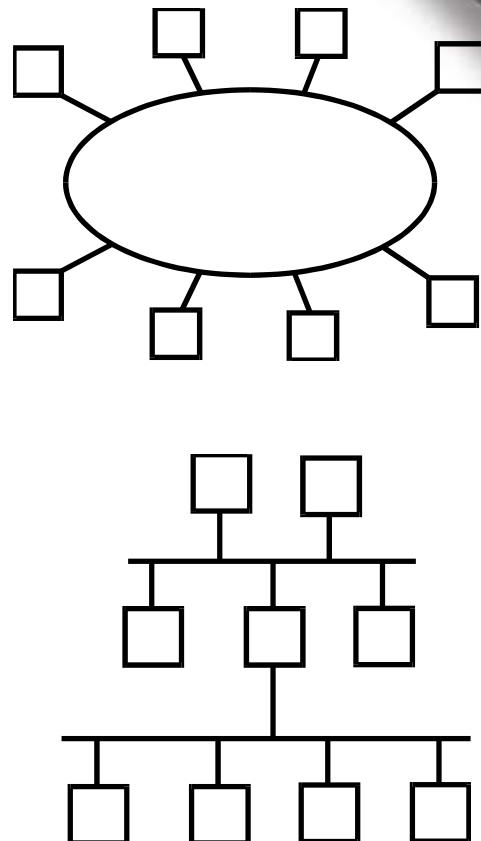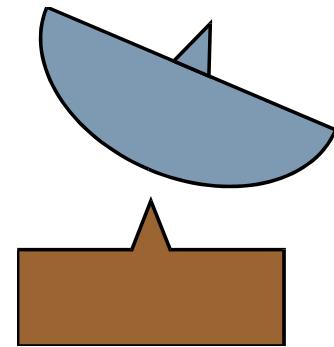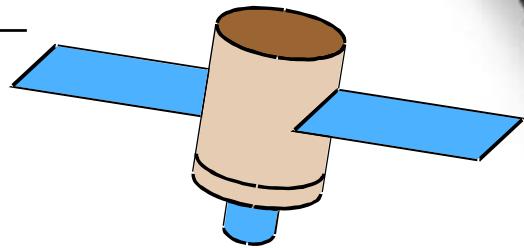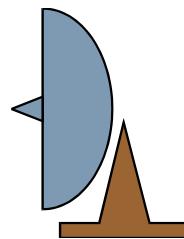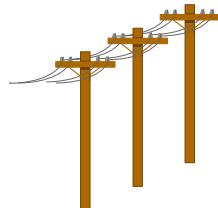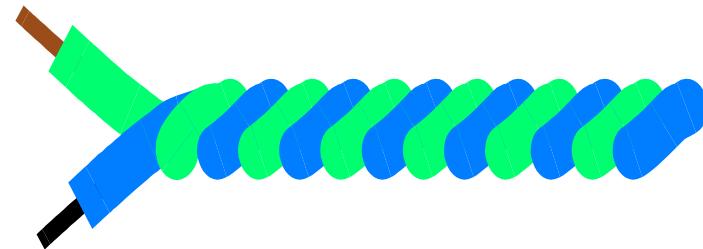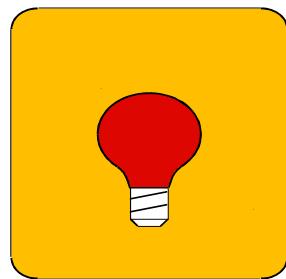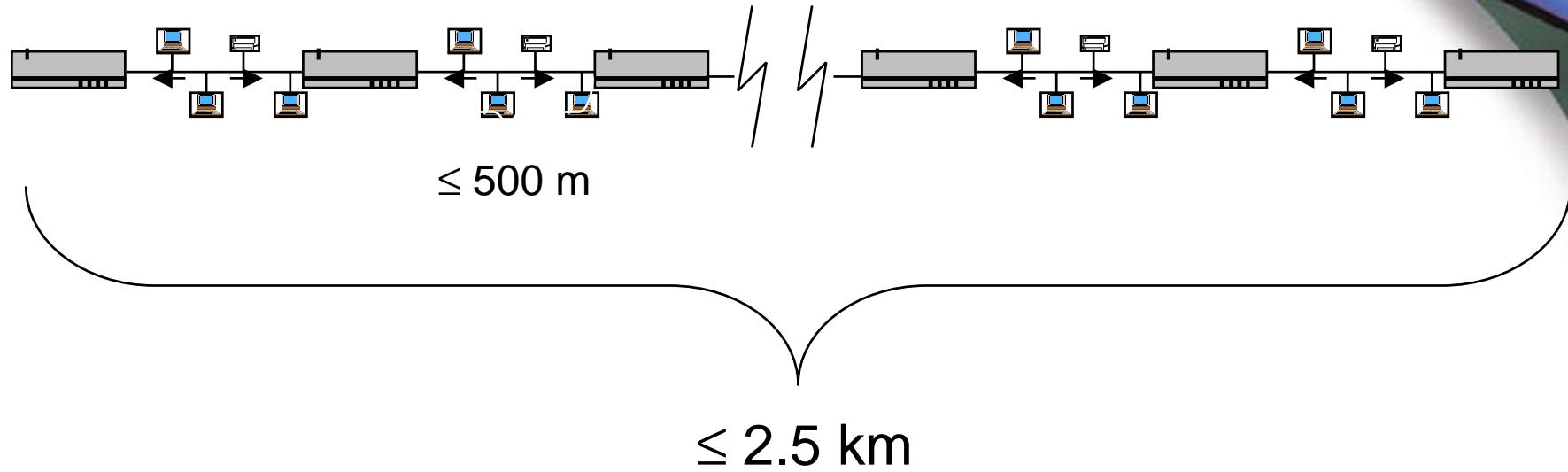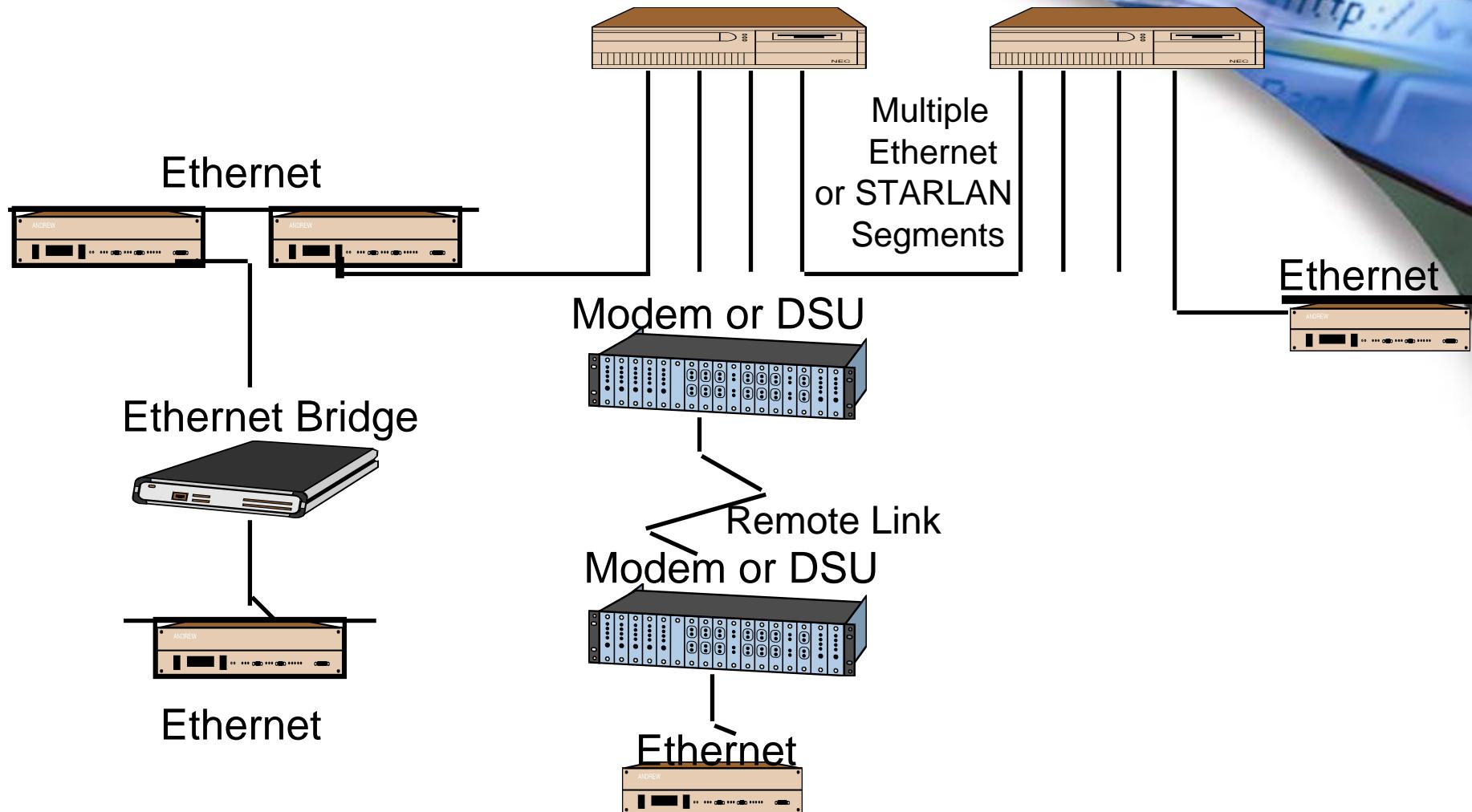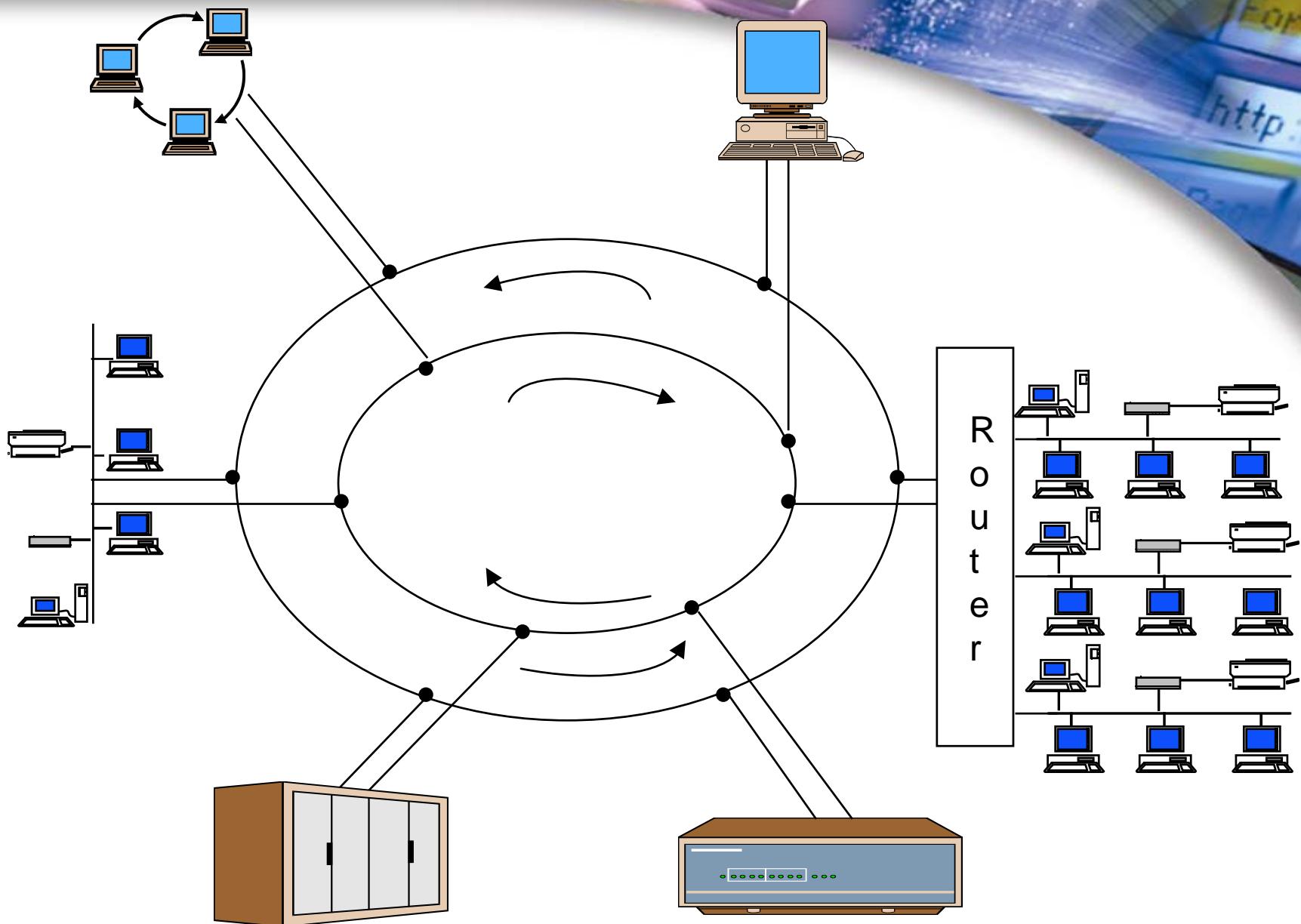
Ethernet Standards
10 Mbps, Baseband

- ## 10Base5: Thicknet Coax

  Good Performance over Distance

  Expensive to Acquire and Deploy

- ## 10Base2: Thinnet Coax

  Shorter Distance

  Still Expensive

- ## 10BaseT: UTP

  Shorter Distance

  Inexpensive

Optical Fiber

- **Bandwidth to Spare**
  - Mbps to Gbps
- **Excellent Error Performance**
  - 10^{-14}
- **Performance over Distance**
  - Meters to Kilometers
- **Fragility is an Issue**

RF WLAN

Hub

Hub

Coax

Server
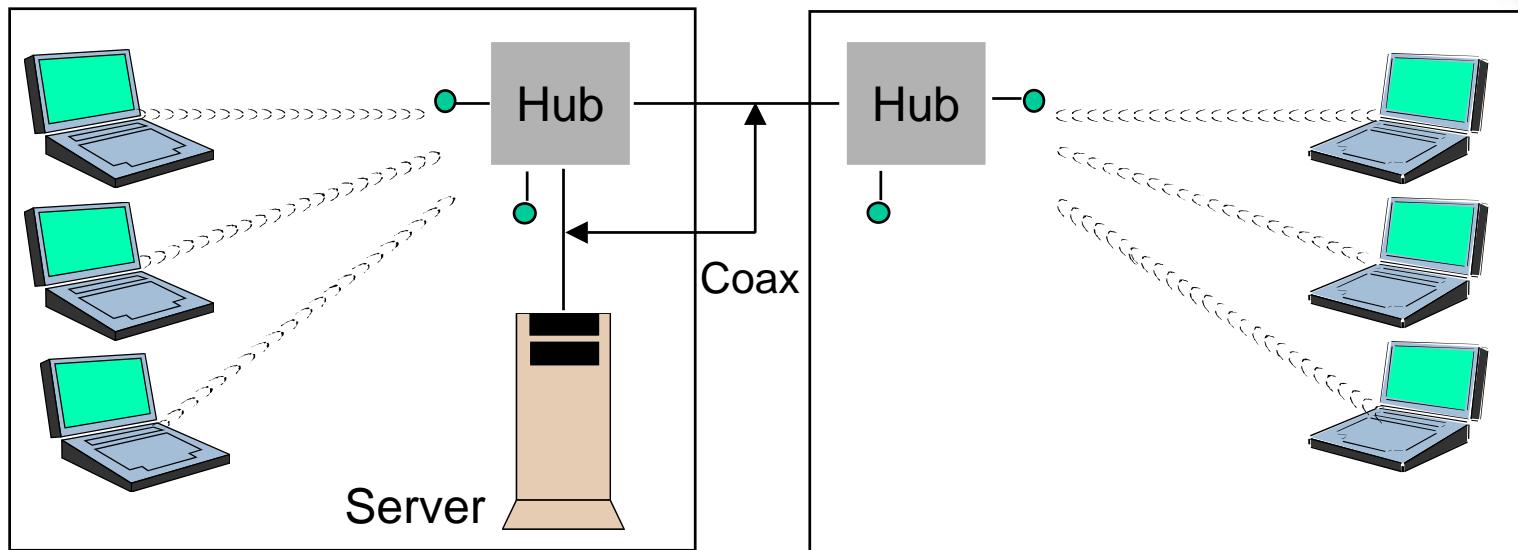
Wireless Means "No Wires"

Infrared

- Optical Airwave
- No Licensing
- Line-of-Sight
- Limited Application
- Whoops! Win2000!

Radio Frequency

- (Un)Licensed
- Interference?
- Security?
- Cost Savings?
- Portability!

Topologies

Bus

Tree
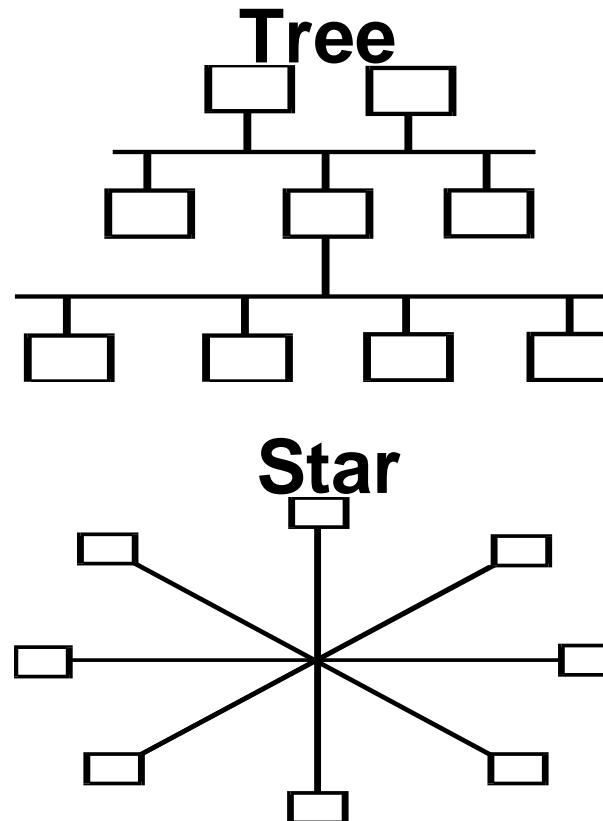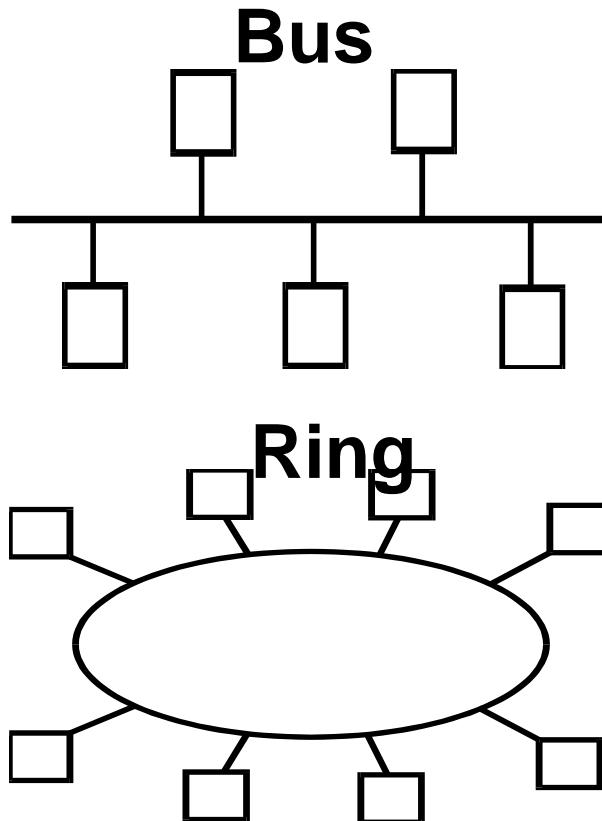
Ring

Star

Ethernet Bus
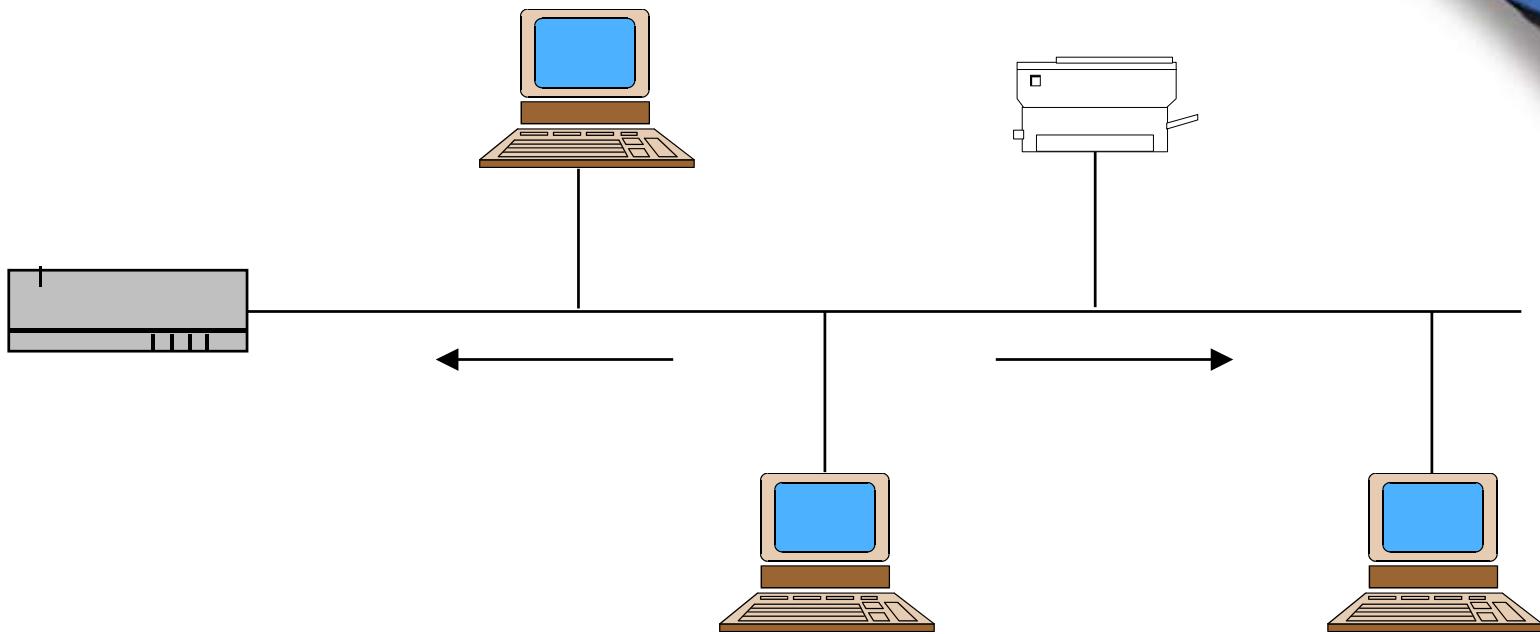
Token Ring
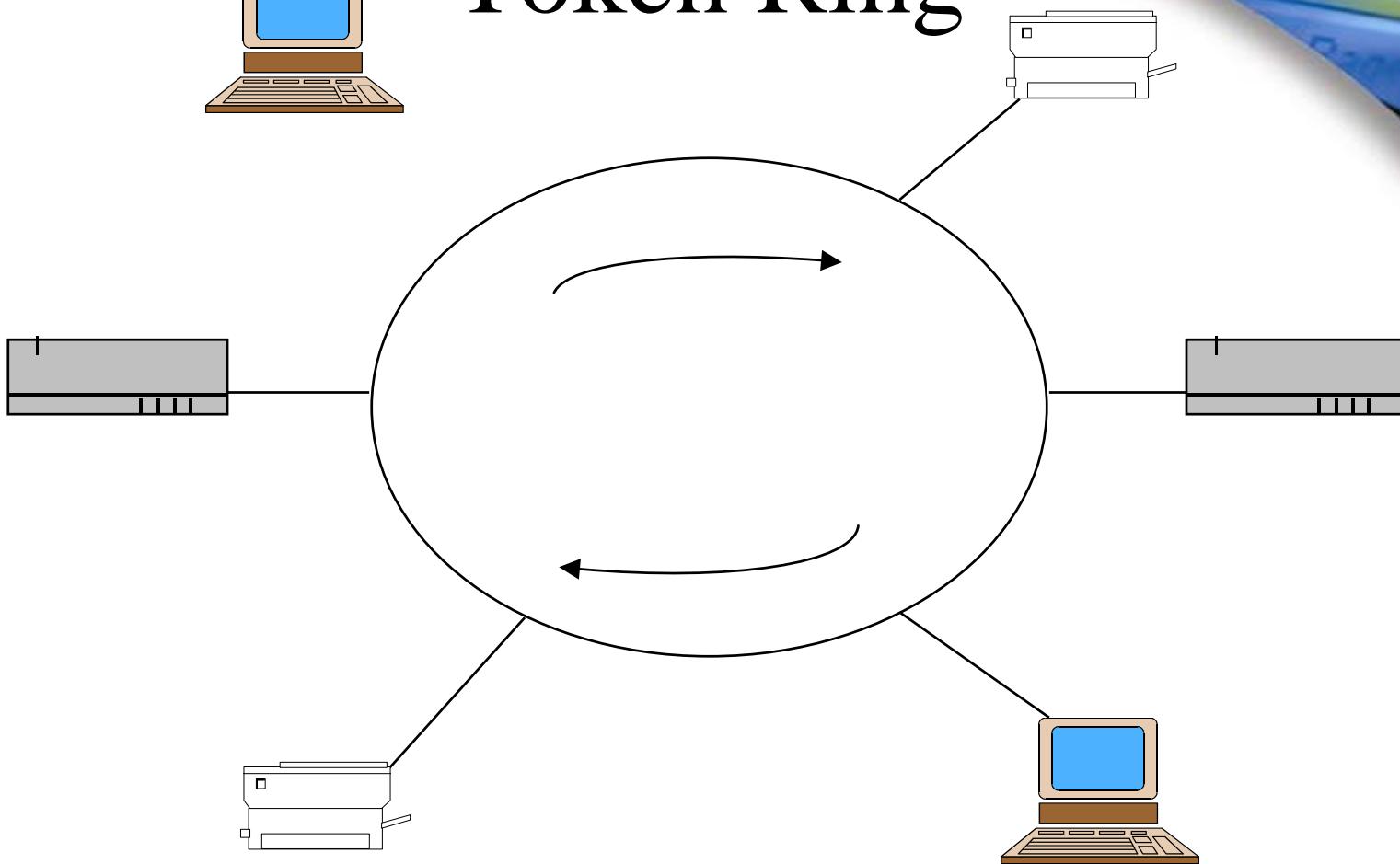
Star
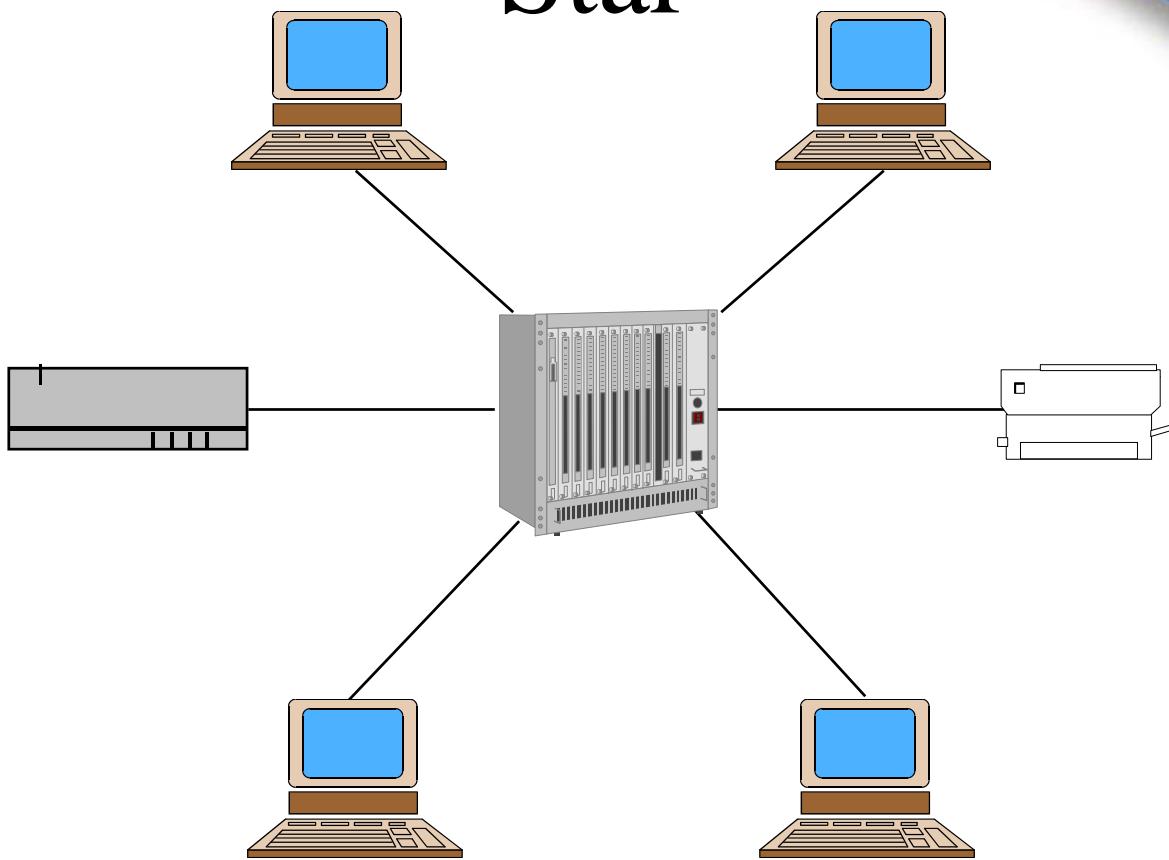
Channel

Broadband = Multichannel, Analog

1

2

3
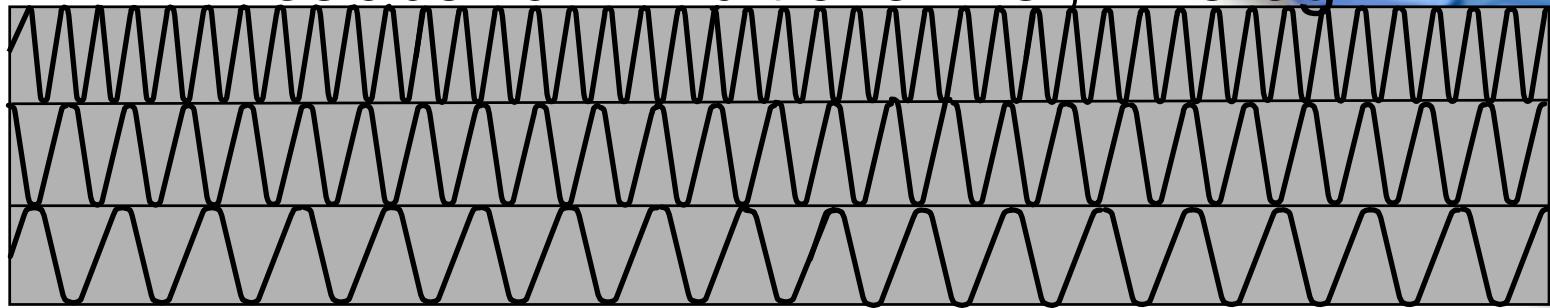
Coax

Baseband = Single Channel, Digital
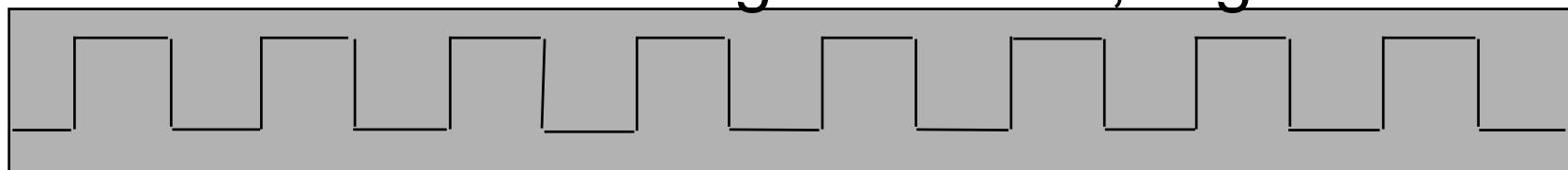
UTP, Coax, or Fiber

Media Access Control

Centralized vs. Decentralized:

Deterministic vs. Non-Deterministic:

Token Passing

(Token Ring, FDDI)

vs.

CSMA/CD

(Carrier Sense Multiple Access/Collision Detect)

(Ethernet)

SD	AC	FC	DA	SA	Info field	FCS CRC-32	ED	FS
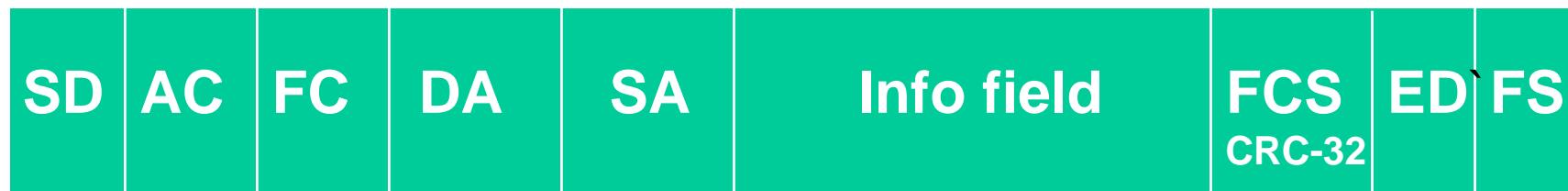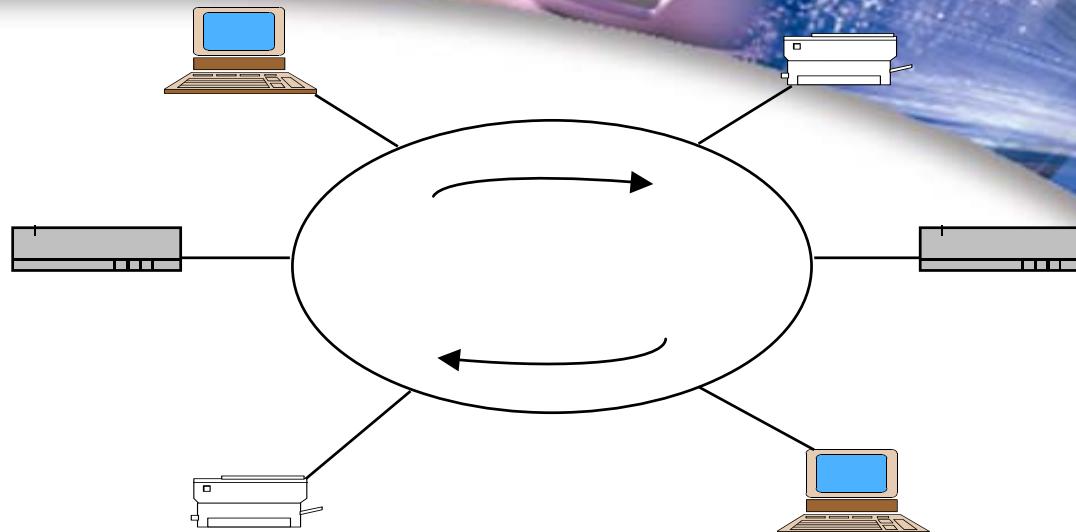
|	SD	AC	FC	DA	SA	Info field	FCS	ED	FS
Octets	1	1	1	2/6	2/6	up to 4048	4	1	1

SD = Starting Delimiter
AC = Access Control
FC = Frame Control
DA = Destination Address
SA = Source Address
FCS = Frame Check Sequence
ED = Ending Delimiter
FS = Frame Status

©Context Corporation
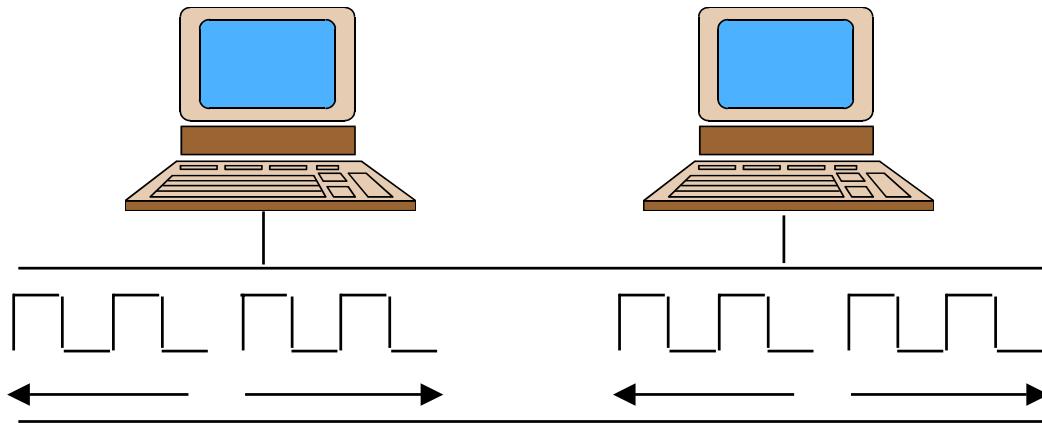
Preamble	Destination Address	Source Address	Data Type	Data	FCS	
8	6	6	2	46-1500	4	octets

NIC
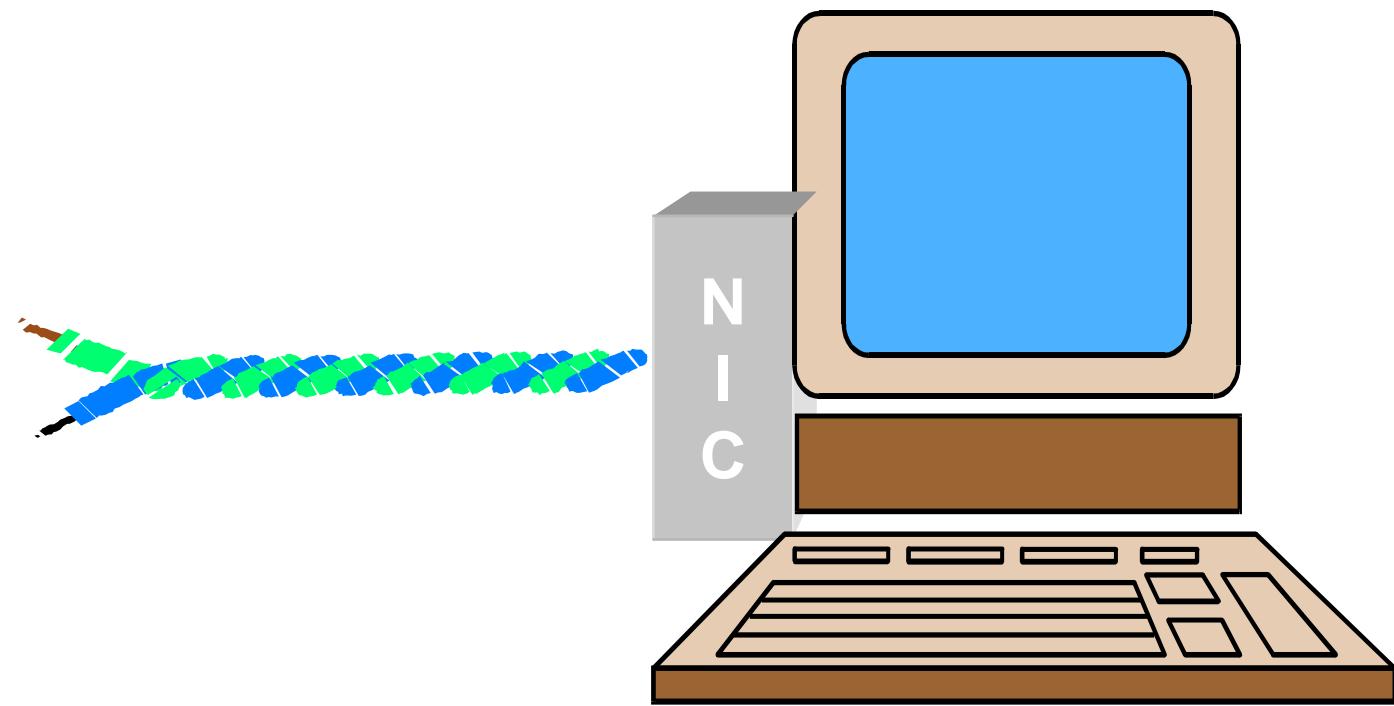
LAN Internetworking

- Bridges
- Hubs
- Switches
- Routers
- Gateways
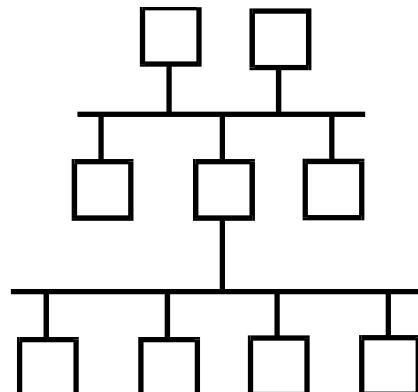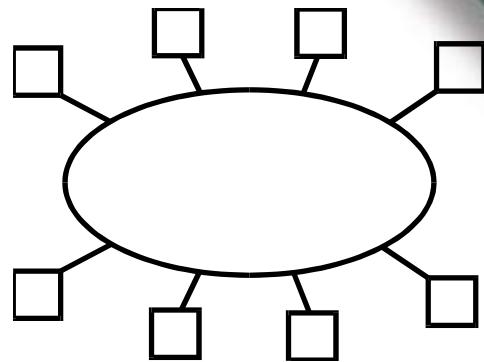
Bridges
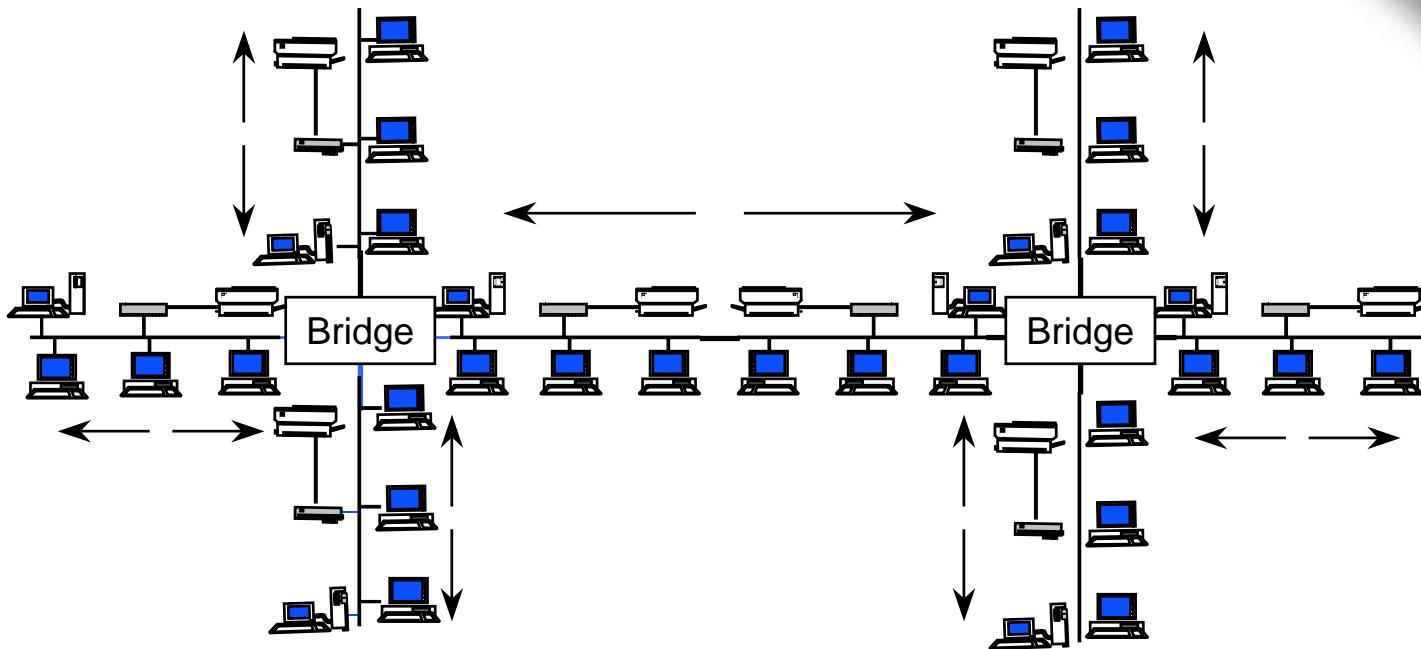
Bridges

- OSI Layers 1 & 2
  - Physical Layer
  - Data Link Layer
- Protocol-Specific
- Fast
- Inexpensive
- Filtering Capability

10/100 Base T

Hubs
"LAN in a Can"

- OSI Layers 1 & 2
  - Physical Layer
  - Data Link Layer
- Protocol-Specific
- Fast
- Inexpensive Box
- Inexpensive UTP (Cat 5)

Hub — Hub

Bridge

Bridge

Ethernet Frame

Token Ring Frame

Ethernet Switch   Ethernet Switch

HUB — 10 Mbps — [10 x10 Mbps] — 10/100 Mbps — [10 x10 Mbps] — 10 Mbps — HUB

HUB — 10 Mbps

10 Mbps

10 Mbps

10 Mbps — HUB

10 Mbps

Buffer — 10 Mbps

Fragmentation

©Context Corporation
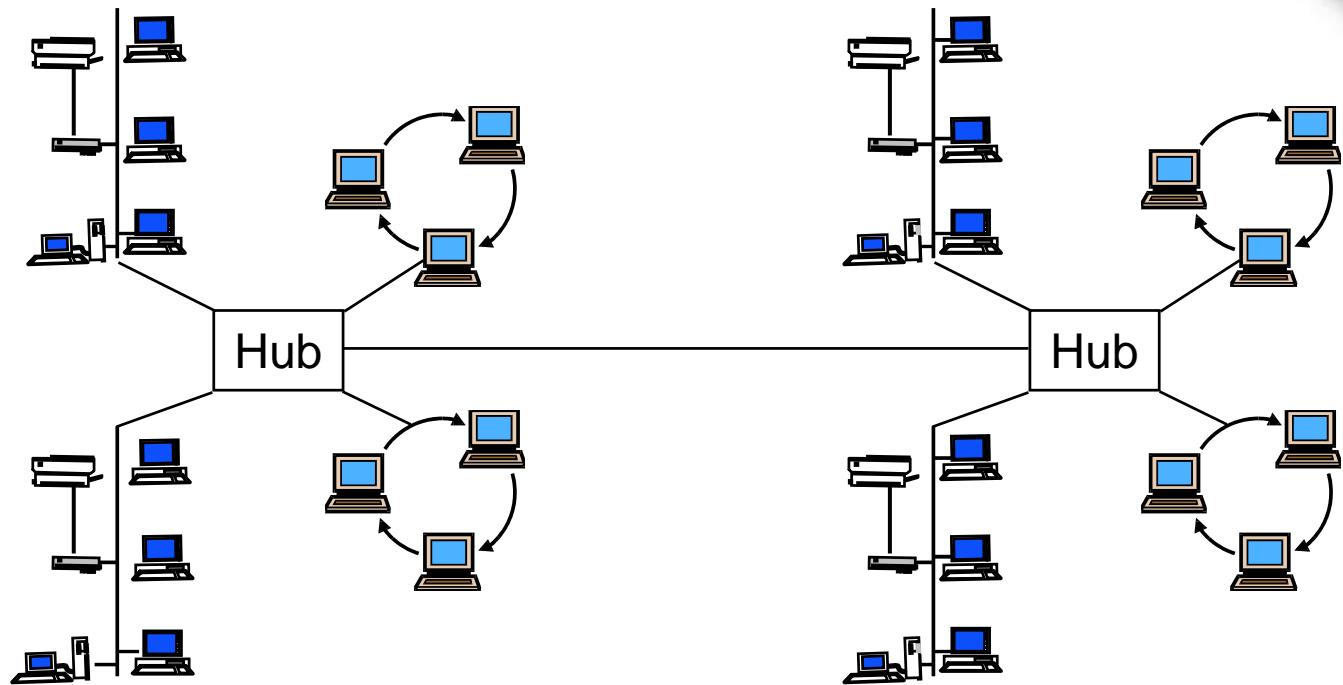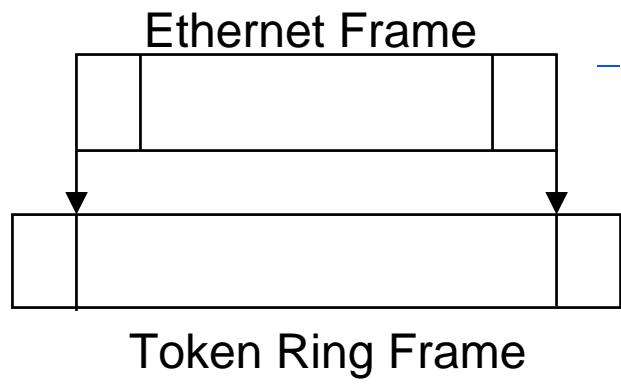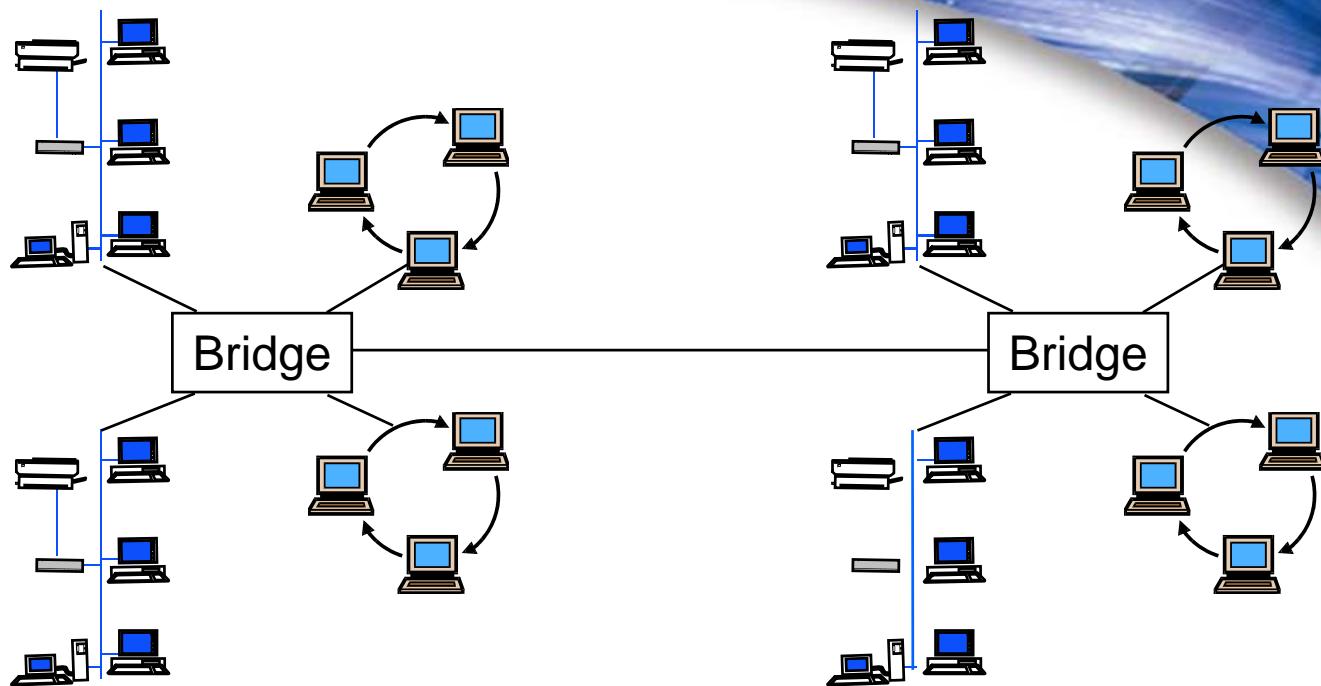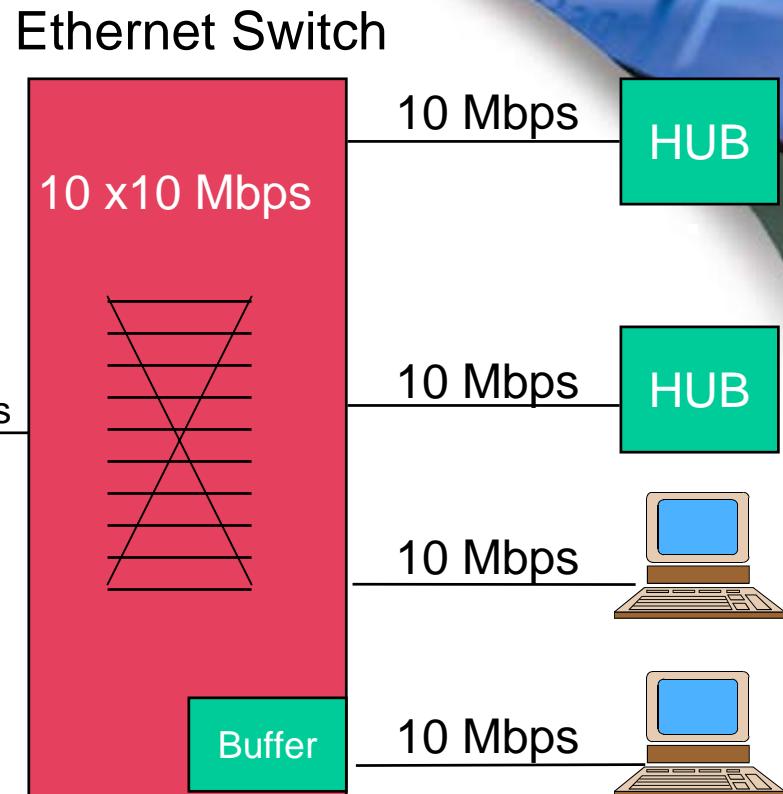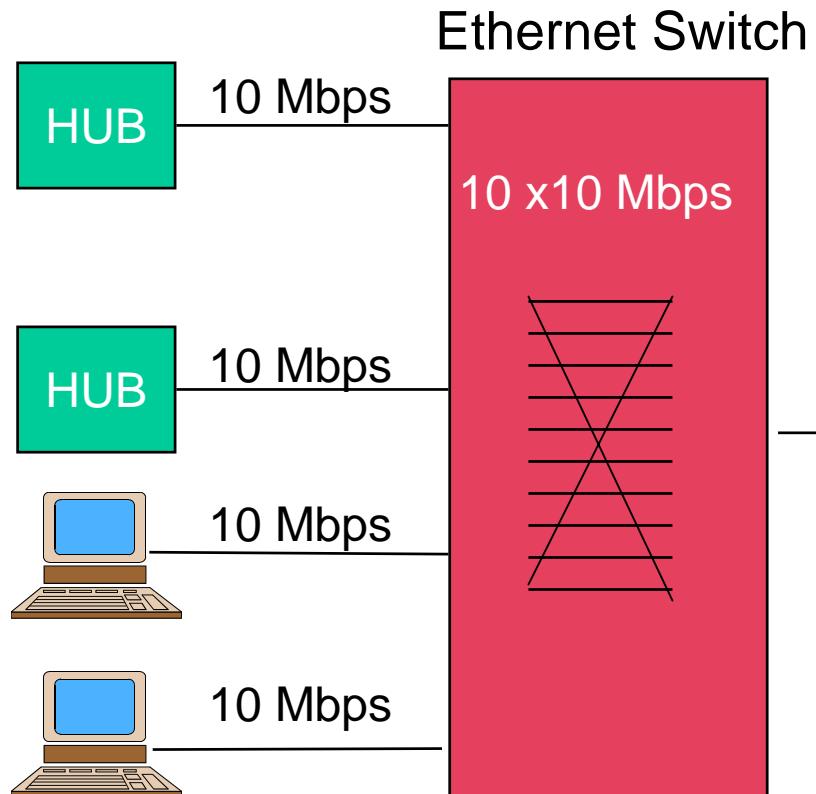
Switches

- OSI Layers 1 & 2
  - Physical Layer
  - Data Link Layer
- Protocol-Specific
- Fast
- Inexpensive
- Congestion Control

Router

Router

Router

IP
WAN

Frame
WAN

ATM
WAN
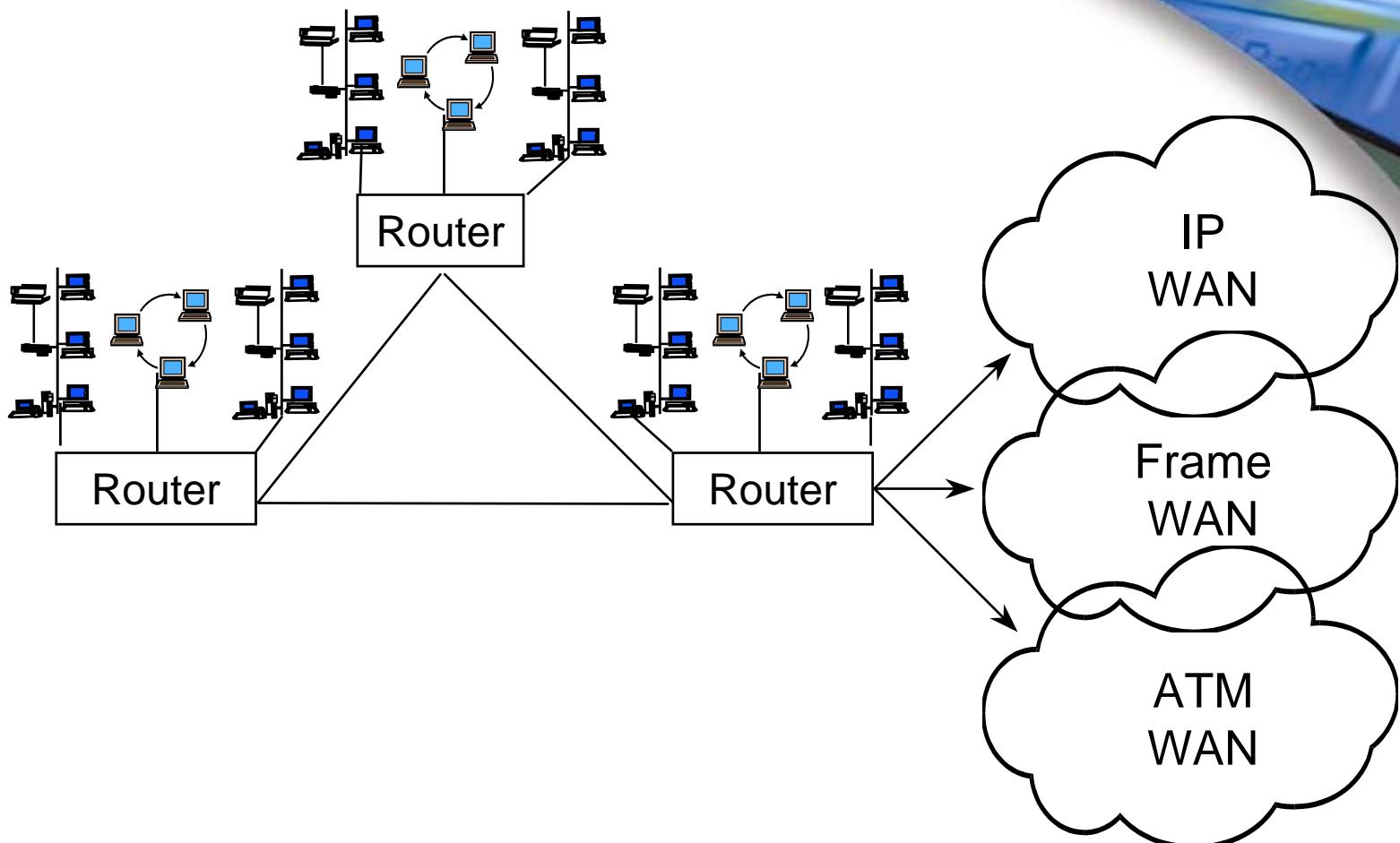
Routers

- OSI Layers 1-7
- Protocol Conversion: Gateways
- Slower, but More Capable
- Expensive, but More Capable
- See Edge-to-Edge
- Security through Subnets
- Security through Firewalls
- Route at the Edge, Switch in the Core

LAN Internetworking: TCP/IP

- Connectionless Packet Delivery (Datagrams)

- Reliable Data Stream Transport

- Network Technology Independent

- Universal Interconnection

- Acknowledgement, End-to-End

- Applications Standards
  - SMTP: E-Mail
  - FTP: File Transfer
  - UDP: Datagrams

©Context Corporation
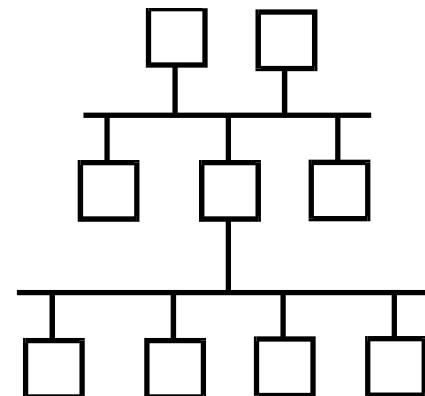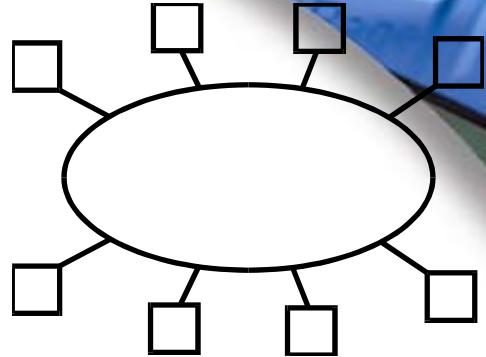
Internet Protocols: Transmission Control Protocol (TCP)

- Layer 4 (Transport)

- Session-Oriented

- Supports Virtual Circuits

- Byte-Stream Oriented

- End-to-End Flow Control

- Error Control

- Connection Set-up

- Status Exchange

- Synchronization
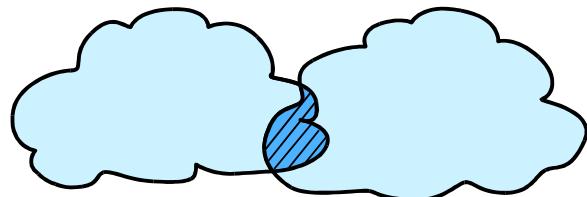
- Layer 3 (Network)
- Datagram-Oriented
- Addressing Conventions
- Routing Control
- Status Translation & Communications
- Supports Multiple Service Types
  - Low-Delay Path
  - High-Bandwidth Path
  - High-Reliability Path

Transmission Framing

Ethernet Header	IP Header	UDP or TCP Header	Application Data	Ethernet Trailer

8 Octets

20 Octets

20 Octets

UDP Datagram
or
TCP Segment

IPv4 Datagram
46-1500 Octets

Ethernet Frame
64-1518 Octets

©Context Corporation

VLAN

= Virtual Workgroup

©Context Corporation

Gigabit Ethernet

Ethernet Hub

Ethernet Switch

HUB — 10 Mbps

HUB — 100 Mbps

10 Mbps

100 Mbps

1 Gbps

Bus

1 Gbps

1 Gbps

10 Mbps — HUB

100 Mbps — HUB

100 Mbps

Buffer — 10 Mbps

Fragmentation

GE In The MAN

Office Park

Office Park

Office Park

IXC Domain

LEC Domain

©Context Corporation

©Context Corporation

FDDI

P	SD	FC	SA	DA	DATA	FCS	ED	FS
≥16	2	2	4 or 12	4 or 12	≤9000	8	1	≥3

4Bytes = Symbol

Symbols

P = Preamble
SD = Starting Delimiter
FC = Frame Control
DA = Destination Address
SA = Source Address
FCS = Frame Check Sequence
ED = Ending Delimiter
FS = Frame Status

ATM Switch

155/622 Mbps

10 Mbps — HUB

100 Mbps — Switch

100 Mbps

100 Mbps

Buffer

Segmentation

Octets

5	48
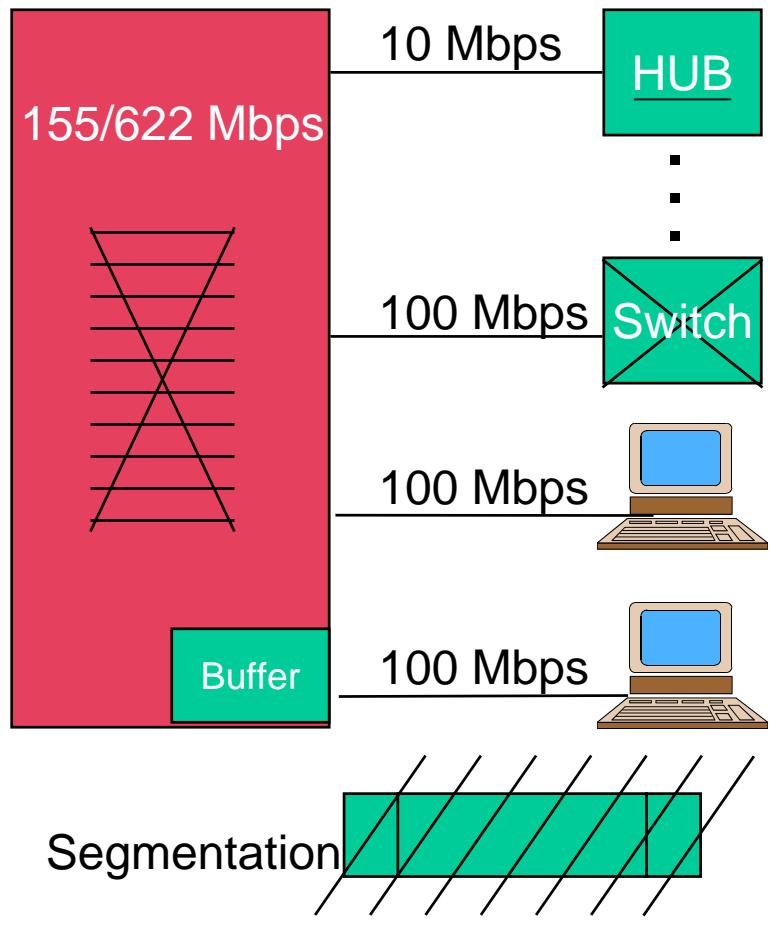
Asynchronous Transfer Mode (ATM)

- Standards-Based

- Fast

- Quality of Service (QoS)
  - Multiple Data Types
  - Voice
  - Video

- Seamless Access to ATM WAN

- Expensive

- Technically Demanding

LAN

LAN

HUB

HUB

HUB

HUB

ATM BB

Router

Router

ATM WG

ATM WG

Server

Server

WAN

©Context Corporation
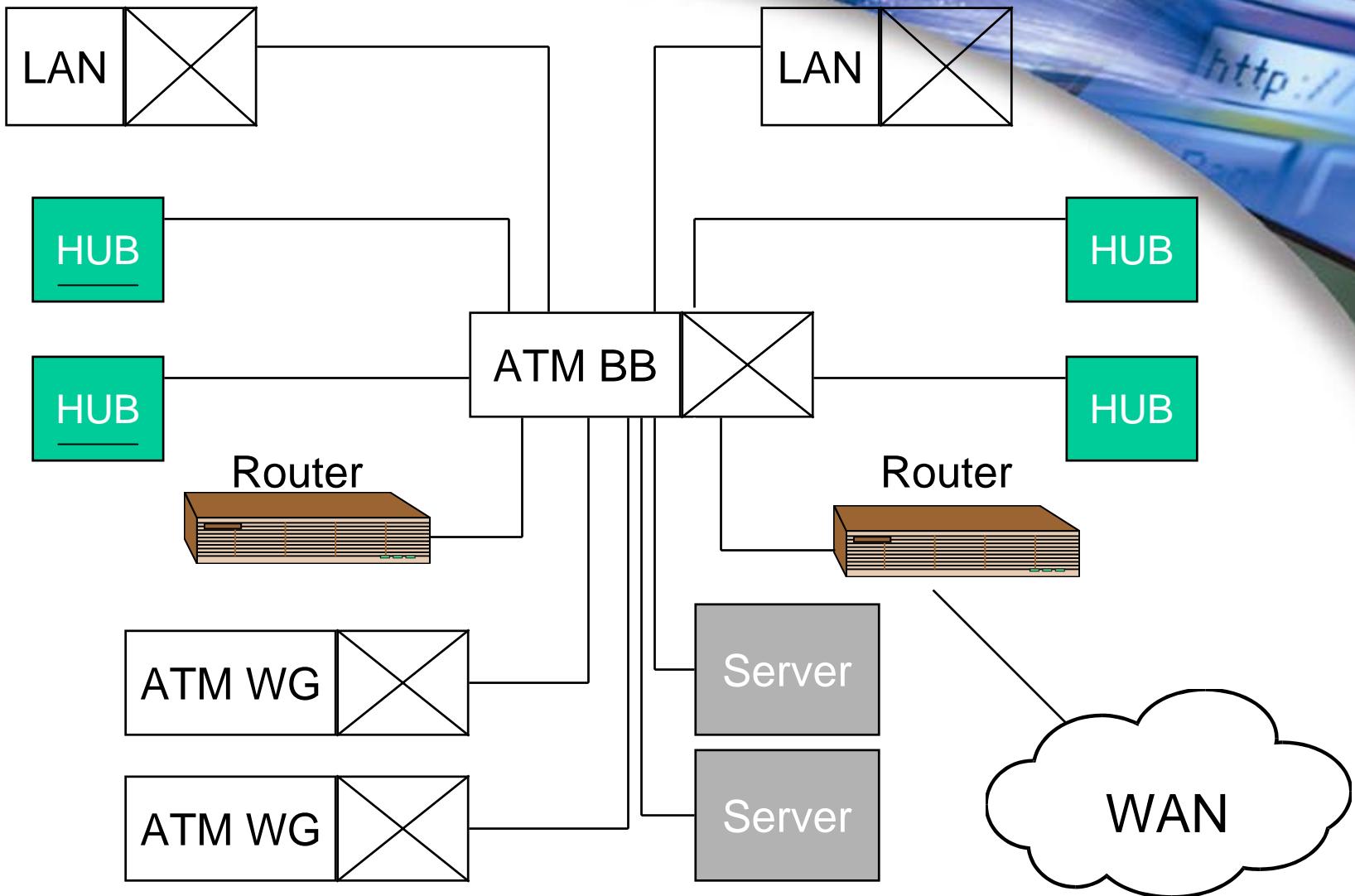
ATM QoS: Service Categories

- Constant Bit Rate (CBR)

- Real-Time Variable Bit Rate (rt-VBR)

- Non Real-Time Variable Bit Rate (nrtVBR)

- Unspecified Bit Rate (UBR)

- Available Bit Rate (ABR)

Thanks! I'm Outta Here!